Studies on Indian Hymenophyllaceae, Part VIII. Contributions to our Knowledge of Mecodium exsertum (Wall.) Copeland

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A study of the Indian species of Hymenophyllaceae has been undertaken in the Department of Botany, University of Lucknow. Earlier papers on *Mecodium badium* (Sharma, 1962), *Crepidomanes latealatum* (Sharma, 1960), *Meringium edentulum* (Rao & Sharma, 1960), *Hymenophyllum simonsianum* (Sharma, 1963), and *Pleuromanes kurzii* (Rao & Khare, 1965) have already appeared. This paper deals with morphological and anatomical investigations of *Mecodium exsertum*. The material was collected by Dr. B. B. Sharma and Dr. D. D. Awasthi in October, 1964, from Darjeeling.[1] It corresponds with *Hymenophyllum exsertum* Wall. ex Hook., as cited by Beddome (1883).

MORPHOLOGY

The plants of *M. exsertum* (*Fig. 20*) are hygrophyllous and epiphytic, measure 6 to 10 cm long, and consist of a jet-black, creeping, branched, hairy rhizome bearing thin-branched, dark-colored roots and two rows of pinnately lobed leaves. The petioles are long, winged, and are smooth above and hairy below. The pinnae are small, narrow, one cell thick, and are traversed by a single midvein. The pinnules have an entire margin, and are 2 to 5 mm long. The apical pinnules are lobed, while the lower ones are free. Short uniseriate hairs 2 to 4 cells long (*Fig. 1A–C*), laterally attached by a short papilla as in *Hymenophyllum simonsianum* (Sharma, 1963), are present. These are the only dermal appendages, and occur on the midribs of the leaves, on the rhizomes, the lower parts of the petioles, and on the sorus also.

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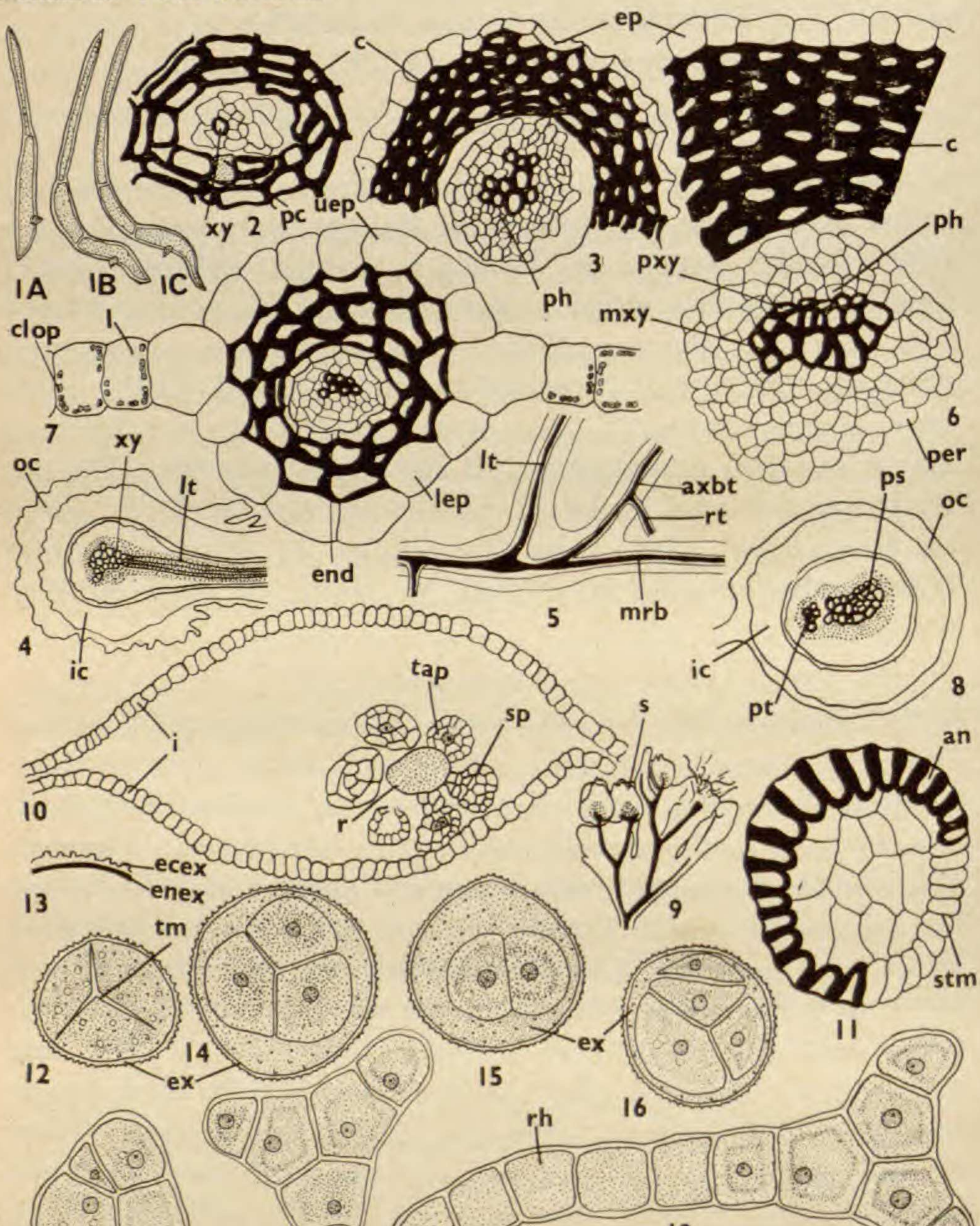
[1]Our best thanks are due these gentlemen. To Dr. B. K. K. Nayar, of the National Botanic Gardens, Lucknow, we are deeply indebted for identifying the material.



Mecodium exsertum

The sorus is terminal on the pinnules (*Fig. 20*). The receptacle is never extruded, and bears the sporangia in basipetal succession (*Fig. 21*). The indusium is cup shaped, united only at the base, and has free lips with toothed margins.

SPOROPHYTE ANATOMY

The cortex of the root is sclerenchymatous, with the outer layers disorganizing. In the innermost layers of the sclerenchyma a thin-walled passage cell (*Fig. 2*, pc) can be seen. The xylem is reduced to just one or two tracheids. The endodermis and pericycle are not clear in old material (*Fig. 2*).

In a transverse section of the rhizome (*Fig. 3*) the epidermis is single layered and thin walled. The cortex is sclerenchymatous and 4 to 6 cells thick. The concentric stele is an exarch protostele with one or two protoxylem points. The endodermis is usually not very distinct due to the breaking of the tissues in this region. The pericycle is 1 to 3 cells thick, as in *H. simonsianum* (Sharma, 1963) and *H. scabrum* A. Rich. (Boodle, 1900). The centrally placed xylem consists of 10 to 18 tracheids. The

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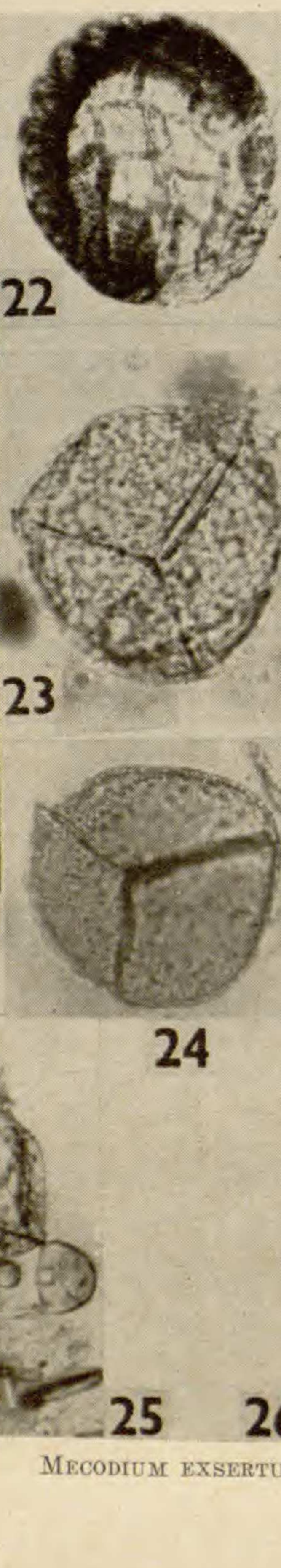
FIG. 1A–C. DERMAL HAIRS, × 25. FIG. 2. PORTION OF TRANSVERSE SECTION OF ROOT, × 250. FIG. 3. TRANSVERSE SECTION OF RHIZOME, × 120. FIG. 4. TRANSVERSE SECTION OF RHIZOME SHOWING DEPARTURE OF LEAF TRACE, × 50. FIG. 5. CLEARED MOUNT SHOWING LEAF TRACE AND AXILLARY BRANCH TRACE, × 15. FIG. 6. PORTION OF THE TRANSVERSE SECTION OF PETIOLE, × 185. FIG. 7. PORTION OF TRANSVERSE SECTION OF THE LEAF, × 185. FIG. 8. TRANSVERSE SECTION OF PETIOLE SHOWING PINNULE TRACE, × 50. FIG. 9. CLEARED MOUNT OF THE SORUS, × 3. FIG. 10. TRANSVERSE SECTION OF THE SORUS, × 50. FIG. 11. SPORANGIUM, × 85. FIG. 12. SPORE, × 250. FIG. 13. EXINE PATTERN, × 565. FIGS. 14–19. EARLY STAGES OF SPORE GERMINATION, × 250. The abbreviations are: an = ANNULUS, axbt = AXILLARY BRANCH TRACE, c = CORTEX, clop = CHLOROPLAST, ecex = ECTOEXINE, end = ENDODERMIS, enex = ENDOEXINE, ep = EPIDERMIS, ex = EXINE, i = INDUSIUM, ic = INNER CORTEX, l = LAMINA, lep = LOWER EPIDERMIS, lt = LEAF TRACE, mrb = MAIN RHIZOME BUNDLE, mxy = METAXYLEM, oc = OUTER CORTEX, pc = PASSAGE CELL, per = PERICYCLE, ph = PHLOEM, ps = PETIOLE SUPPLY, pt = PINNULE TRACE, pxy = PROTOXYLEM, r = RECEPTACLE, rh = RHIZOID, rt = ROOT TRACE, s = SORUS, sp = SPORANGIUM, stm = STOMIUM, tap = TAPETUM, tm = TRIRADIATE MARK, uep = UPPER EPIDERMIS, xy = XYLEM.



Mecodium exsertum

phloem is more developed on the dorsal side. Root and leaf traces are given off from the protoxylem points of the stele (*Fig. 4*). The stele in this plant is comparable to that of the *Mecodium* subtype of the *Hymenophyllum* type (Nozu, 1950). Leaf traces are formed without leaf gaps (*Fig. 5*). The axillary branch trace comes off from the main axis strand after the leaf trace has separated from it. All the traces are, like those of the axis, protostelic and exarch, a primitive feature that is characteristic of the Hymenophyllaceae.

A transverse section of the petiole (*Fig. 6*) shows the outer, thin-walled, one-cell-thick epidermis and below it the thick-walled, narrow-lumened, sclerenchymatous cortex. The endodermis is not distinct. The pericycle is 2 to 4 cells thick, enclosing the platelike exarch xylem, with the phloem present all around. The condition is comparable to that in *H. tunbridgense* (Boodle, 1900).

In transverse section (*Fig. 7*) the leaf is one cell thick with chloroplasts mostly appressed to the walls of the cells. The midrib is thick and sclerenchymatous. The endodermis is clear in young stages. The pericycle usually consists of 1 or 2 layers of cells enclosing the platelike exarch xylem, which has phloem on one side. The pinna trace is abstricted from the leaf trace (*Fig. 8*). In the tip region of the pinnule the vascular element is replaced by parenchyma.

The sorus is terminal on the pinnules, and is about 1 to 1.5 mm long. The receptacle is elongated within the involucre (*Fig. 9*). The indusium is hairy and is deeply lobed, the lobes being dentate. Chloroplasts are present in the cells, as in *Crepidomanes latealatum* (Sharma, 1960) and *Pleuromanes kurzii* (Rao & Khare 1965). The sorus is gradate (*Fig. 21*), basi-

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FIG. 20. HABIT, × 1. FIG. 21. LONGITUDINAL SECTION OF THE SORUS, × 135. FIG. 22. SPORANGIUM, × 20. FIG. 23. SPORE SHOWING ORNAMENTATION, × 425. FIG. 24. SPORE SHOWING TRIRADIATE MARK, × 425. FIG. 25. YOUNG STAGE OF SPORE GERMINATION; THE EXINE IS STILL ATTACHED TO THE GAMETOPHYTE, × 360. FIG. 26. YOUNG GAMETOPHYTE WITH RHIZOIDAL END, × 265.

petal, but occasionally slightly mixed also (*Fig. 10*). A similar condition has been reported by Sharma (1960) in *Crepidomanes latealatum*. In a transverse section of the sorus (*Fig. 10*), one or two developing sporangia are seen. Satisfactory material for tracing the development of the sporangia was not available, but in a few of the sporangia in the sori (*Fig. 10*) the sporogenous cell, the jacket cells, and the tapetum could be seen clearly.

The short-stalked sporangium (*Fig. 11*) is about 350 μ × 298 μ, having an incomplete annulus of 15 to 20 thick-walled cells and a well-marked stomium of 8 to 12 cells. The dehiscence is by a lateral transverse slit. Air spaces have been observed in the annulus cells extending up to the middle lamellae, as in *Hymenophyllum simonsianum* (Sharma, 1963).

The spores are tetrahedral with a tri-radiate mark, and measure 60 μ × 70 μ *(Fig. 12)*. The exine *(Fig. 13)* is 3.2 μ thick, with a 1.6 μ thick, smooth endoexine and an equally thick, granulate ectoexine; granulae are variable in size. The spore contents include some oil globules along with chloroplasts and starch grains. About 110 spores could be counted in a sporangium.

GAMETOPHYTE ANATOMY

Germination of spores could not be undertaken, as only alcohol-preserved material was available. Some spores which had already germinated in the sporangia showed some early stages of gametophyte formation. The earliest stage shows the division of the spore into three unequal, uninucleate cells by septation. The exine becomes quite loose by this time (*Fig. 14*). One cell then divides by a transverse or an oblique wall (*Fig. 16*). The exine now separates (*Fig. 17*), and the other two cells also undergo similar divisions, resulting in a six-celled, triangular body (*Fig. 18*). At this stage one or more rhizoidal ends may develop, which soon lose their chloroplasts. Sharma (1962) has observed more than one rhizoid developing in one set of cells. Rhizoid formation usually starts from the third cell (*Fig. 19*),

but it may develop from the second or even the fourth cell. Further developmental stages could not be observed in the preserved material, but Sharma (1962) has described and figured some stages where an apical cell plate is formed, which she regards as the initiation of an apical meristem. No hairs have been found on the young gametophyte, which is in conformity with the observations of Sharma (1962) and Stokey (1960). The development of the gametophyte in early stages resembles that of *M. badium* (Sharma, 1962), *Hymenophyllum* spp. (Stokey, 1940), and *Trichomanes reniforme* (Holloway, 1930).

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Ferns New to Illinois

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During the preparation of a treatment of the ferns for the first volume of a projected illustrated flora of Illinois,[1] a rather remarkable number of ferns and fern allies previously unreported from Illinois were discovered. Some of the new records are the result of extensive field work throughout the state during the last few years, while others were discovered through intensive searches of various herbaria in the country. Eight species and two varieties are reported in this paper for the first time from Illinois. Unless otherwise indicated, all specimens cited are mine and are deposited in the herbarium of Southern Illinois University.

BOTRYCHIUM BITERNATUM (Sav.) Underw.

This evergreen fern, which is distinguished from *B. dissectum* by its sharply serrate pinnules and its membranous blades which remain green during the winter, was discovered growing near the base of an open hillside in Little Grand Canyon, nine miles southwest of Murphysboro, Jackson County, on August 10, 1963 (*15150*). Associated species included a few specimens of *B. dissectum* var. *obliquum*. The dominant trees of the lower slope were white oak and beech. This is the species which in the past has been known mostly as *B. obliquum* var. *tenuifolium*, but Wagner[2] has given reasons for recognizing it as a species, in which case the correct name is *B. biternatum*.

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[1]Amer. Fern J. **56**: 37. 1966.

[2]Taxon **10**: 165–169. 1961.